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In the fiscal years 1992 through 1994 over 100 million dollars in contracts were terminated for default by the Department of the Navy (DON) alone. There is a need for the Department of Defense (DOD) and the DON to develop or use an accurate and dependable means for assessing which contractors will be able to remain financially capable of fulfilling the terms of their contracts. Currently the Navy uses standard accounting measures and other financial accounting ratios to determine the financial capability of prospective contractors. While the standard accounting ratios and measures have performed adequately, it is possible that improved measures,such as Economic Value Added (EVA™), may exist.

This thesis provides some evidence, based on statistical tests using EVA™ data and financial ratio data for the years 1983 through 1992, on the potential value of EVA™ as an information item. Specifically, this study determined that EVA™ was unique and distinct from traditional accounting ratios and that past EVA™ is an effective predictor of future EVA™.

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AN ANALYSIS OF ECONOMIC VALUE ADDED (EVA™) AS A MEASURE OF FINANCIAL PERFORMANCE AND RISK ASSESSMENT

by

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MASTER OF SCIENCE IN MANAGEMENT

from the

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ABSTRACT

In the fiscal years 1992 through 1994 over 100 million dollars worth of contracts were terminated for default by the Department of the Navy (DON) alone. There is a need for the Department of Defense (DOD) and the DON to develop or use an accurate and dependable means for assessing which contractors will be able to remain financially capable of fulfilling the terms of their contracts. Currently the Navy uses standard accounting measures and other financial accounting ratios to determine the financial capability of prospective contractors. While the standard accounting ratios and measures have performed adequately, it is possible that improved measures,such as Economic Value Added (EVA™), may exist.

This thesis provides some evidence, based on statistical tests using EVA™ data and financial ratio data for the years 1983 through 1992, on the potential value of EVA™ as an information item. Specifically, this study determined that EVA™ was unique and distinct from traditional accounting ratios and that past EVA™ is an effective predictor of future EVA™.

TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

This thesis is an analysis of Economic Value Added™[1], hereafter referred to as EVA™, as a financial measurement tool. The primary focus is to evaluate the information value of EVA™ to entities ***external*** to the companies being evaluated (using EVA™). The external users of this information, for the purpose of this study, will be the Department of the Navy (DON) and to a lesser extent the Department of Defense (DOD). The majority of prior research in the area of EVA™ has dealt with EVA™ as an ***internal*** performance measurement tool, making this thesis one of the first studies to analyze the external applications of EVA™.

There is a need for the Department of Defense (DOD) and the Department of the Navy (DON) to develop or use an accurate and dependable means for assessing which contractors will be able to remain financially capable of fulfilling the terms of their contracts. In the fiscal years 1992 through 1994 over 100 million dollars worth of contracts were terminated for default by the DON alone[Ref. 23].

The U. S. Navy is evolving into a smaller more streamlined organization due to the rapidly changing geo-political shape and climate of the world and tightening fiscal constraints imposed by Congress, the President and the Department of Defense. Consequently, the number and dollar size of Navy contracts are growing smaller, as well. Optimizing the use of the Navy's financial resources is one of the key factors essential to maintaining the desired level of readiness, in light of the current budgetary environment. Toward this end, it is essential that the Navy make sound

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[1]Economic Value Added and EVA are trademarks of Stern Stewart & Company.

decisions when contracting for goods and services. The Navy cannot afford to waste scarce procurement funds on contractors who cannot fulfill the terms of their contract due to financial or financing difficulties. In order to determine if a prospective contractor is financially capable of fulfilling the terms of the contract, the Navy requires a set of accurate and dependable tools.

Currently the Navy uses standard accounting measures such as earnings, earnings per share, earnings growth, retained earnings, rate of return, dividends, cash flow and many other financial and accounting ratios to determine if a prospective contractor is financially capable of fulfilling the terms of the contract, or what the Navy defines as **responsible**. The Competition in Contracting Act of 1984 defines responsible as

> "...a prospective contractor who:
>
> 1. has ***adequate financial resources*** to perform the contract or the ability to obtain such resources;..."

While the standard accounting ratios and measures have performed adequately, it is possible that improved measures may exist. EVA™ is one measure that has become increasingly visible in recent years. This thesis provides some evidence on the potential value of EVA™ as an information item.

If EVA™ is found to be a more accurate predictor or more efficient measure of financial performance, then application of the EVA™ measure by the U.S. Navy in assessing prospective contractor responsibility or risk could provide substantial cost savings through a lower contract default rate due to financial insolvency.

B. OBJECTIVES

The objective of this thesis is to analyze and evaluate Economic Value Added (EVA™) as a financial performance

measurement tool. The specific area of investigation is: The value of EVA™ as an information source to those external to the firm, in particular the Department of Defense (DOD) and Department of the Navy (DON).

C. RESEARCH QUESTIONS

1. Primary Question

Does the EVA™ measure provide information beyond what is currently available in traditional accounting measures?

2. Secondary Questions

a. Can EVA™ be surrogated by a simple combination of traditional accounting measures?

b. Is EVA™ statistically distinct from traditional accounting measures or does it show some degree of correlation to one or more of the traditional accounting measures?

c. Assuming EVA™ does measure some ultimate success criterion, thus making it a plausible objective of any firm to maximize EVA™, are past EVA™ ratings an effective predictor of future performance/EVA™ ratings?

d. Assuming EVA™ does measure some ultimate success criterion, thus making it a plausible objective of any firm to maximize EVA™, do past accounting ratios/measures predict future EVA™ ratings?

e. Are there benefits to the U.S. Navy in using EVA™ ratings, in lieu of the traditional accounting measures now used, to evaluate potential contractors in Pre-Award Surveys?

D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

This thesis is an analysis of Economic Value Added™ (EVA™) as a source of financial information for the Department of Defense (DOD) and the Department of the Navy (DON) in their assessment of prospective contractors. The thesis involves an in depth analysis of 45 top defense contractors for the years 1983 through 1992 using EVA™ and comparing the results to

traditional accounting measures of the same 45 defense contractors over the same time period.

It was assumed from the start that the Navy does financial analyses of potential contractors and that the tools currently used are adequate. This thesis will attempt to determine if the Navy can do better using EVA™. This thesis will:

1) Statistically compare EVA™ to commonly used traditional accounting measures to determine if there is incremental information content provided by EVA™, and

2) determine if EVA™ can be surrogated by existing accounting measures.

This thesis will not:

1) Provide a definitive answer to the question of EVA™ as a guide to prospective contractor evaluation, and

2) compare EVA™ and commonly used "traditional accounting measures" as competing predictors of contractor default/bankruptcy.

E. THESIS ORGANIZATION

This chapter covered the background of this research effort and identified the primary and secondary research questions addressed in this study. In the next chapter, Chapter II, the background, genesis, and literature review of EVA™ will be reviewed. Chapter III will describe the research methodology employed in the study, including: the sample selection, data, measures, and the structure of tests. The analysis and findings of the tests conducted on the data collected from the 45 defense contractors will be presented in Chapter IV. Conclusions, recommendations, suggestions for further research, and the answers to the research questions will be offered in Chapter V.

II. THE BACKGROUND AND EXPLANATION OF EVA™

A. INTRODUCTION

This chapter will discuss the origins and the concepts of Economic Value Added (EVA™). It begins with the theories and foundations that lead to the development of EVA™. The next section, What EVA™ Is, explores the basic concept of EVA™, the relationship of EVA™ to Net Present Value (NPV), Market Value, and Residual Income. Section C reveals how EVA™ is calculated. The final section is a review of literature published about EVA™.

B. GENESIS

"It is the practical development of the concept of free cash flow (FCF), which is the very foundation upon which corporate values stand."[Ref. 1,p.xvii] EVA™ and Market Value Added (MVA™) are logical extensions of the concept of free cash flow, a theory first introduced in 1961 by Professors Franco Modigliani and Merton Miller [Ref. 2]. Free cash flow has been further refined, studied and applied as a means of measuring corporate performance over the last 30 years by Joel M. Stern, Managing Partner, Stern Stewart & Company. But it was Bennett Stewart (the other half of Stern Stewart) that put together the latest and most widely used version of the free cash flow concept - EVA™.

C. WHAT EVA™ IS

1. The EVA™ Concept

EVA™ is operating profits less the cost of all of the capital employed to produce those earnings. EVA™ increases if operating profits can be made to grow without tying up more capital. EVA™ will also increase if new capital can be invested in projects that will earn more than the full cost of the capital or if capital can be diverted or liquidated from

business activities that do not provide returns beyond the full cost of the capital invested in them.[Ref. 1]

EVA™ will be reduced if management invests money on projects that earn less than the cost of capital. EVA™ will be reduced if management forgoes new business projects that are likely to earn more than the cost of capital.[Ref. 1]

2. The Relationship Between EVA™ and NPV

EVA™ is a measure of performance for a specific period of time (i.e. one year) and is conceptually related to Net Present Value (NPV). Discounting the annual EVA™ to be generated by an individual capital project automatically yields its net present value (NPV). The cost of new capital used to finance the new project is subtracted in the calculation of EVA™. Capital budgeting using NPV recommends that all positive NPV projects should not be rejected. Using the same logic, all positive EVA™ projects should be accepted because for a single project NPV and EVA™ are conceptually the same.[Ref. 1]

3. The Relationship Between EVA™ and Market Value

Applying the theoretical relationship between EVA™ and NPV to the next higher level, projecting and discounting EVA™ for an entire company will automatically sum the net present value of all of the company's past and future capital investment projects. The sum of the net present values is the company's market value premium to capital employed (which is the total of all investments the company has made to date). The market value premium can also be called Market Value Added (MVA). For example, if a company has a discounted projected EVA™ of $1 billion and is currently using $10 billion of capital, then the company has an intrinsic market value of $11 billion.[Ref. 1]

When EVA™ is expected to be positive, the company has added value (i.e. earned $1.10 for every $1.00 employed) and their stock should sell at a premium. If EVA™ is expected to

be negative the company the company has lost value (i.e. $.90 for every $1.00 employed) and their stock should sell at a discount.[Ref. 1]

4. The Relationship Between EVA™ and Residual Income

EVA™ is residual income. Residual income is operating profits less a charge for the capital used to create those profits. Put another way, EVA™ is the difference between the profits the company earns from its operations and the charge for capital incurred through the company's use of financial resources. Mathematically EVA™ looks like this:

$$\mathbf{EVA^{TM} = (r - c^*) \times Capital} \qquad (1)$$

where ***r*** is the actual rate of return earned on capital, ***c**** is the cost of capital, and ***capital*** represents the economic book value of the capital committed to the business. Stewart defines economic book value as standard accounting book value plus equity equivalents[Ref. 1, p. 91]. Equity equivalents will be discussed later in this section.[Ref. 1]

D. CALCULATING EVA™

Recall from the previous section that, conceptually, EVA™ is:

$$\mathbf{EVA^{TM} = (r - c^*) \times Capital} \qquad (1)$$

and given that the rate of return ***r*** is defined as follows:

$$r = \frac{NOPAT}{capital} \qquad (2)$$

where ***r*** is rate of return, ***NOPAT*** is Net Operating Profit After Taxes, and ***capital*** is the sum of all cash that has been invested in a company's net assets over its life.[Ref. 1] Thus EVA™ is based on three components: rate of return (***r***), cost of capital (***c****), and ***capital***; or, alternatively, rate of return (***r***), ***NOPAT***, and ***capital***. To operationalize

these components several transformations of traditional accounting information are required.

1. The Rate of Return Calculation

One of the more unique aspects of EVA™ is how the rate of return is computed. Stewart [Ref. 1] computes it two different ways: 1) from a Financing Perspective, and 2) from an Operating Perspective.

a. The Financing Perspective

The Financing Perspective has three steps. The first step is to *Deleverage the Rate of Return*. In deleveraging, the idea is that most rate of return measures rely on traditional accounting measures of net income and stockholders equity. Those measures, however, are fundamentally affected by the mixture of debt and equity in a firm's capital structure (leverage). The intent here is to create a return measure unaffected by capital structure - one that is "deleveraged." The rate of return is deleveraged by adding all interest-bearing debt (and the present value of noncapitalized leases) to common equity and the interest expense on the debt (including the yet to be realized interest in rents) to the "bottom-line accounting profits"[Ref. 1]. Recalling the rate of return equation (Equation 2) from above:

$$r = \frac{\text{NOPAT}}{\text{capital}} \tag{2}$$

where ***r*** is rate of return, ***NOPAT*** is Net Operating Profit After Taxes, and ***capital*** is the sum of all cash that has been invested in a company's net assets over its life.[Ref. 1] NOPAT and capital defined mathematically, for this particular step, are as follows:

$$\text{NOPAT} = \text{Income available to common share holders} + \text{Interest expense after taxes} \tag{3}$$

and

$$\text{CAPITAL} = \text{Common equity} + \text{Debt} \tag{4}$$

The second step in the Financing Perspective is to improve the "accuracy" of the rate of return by eliminating what Stewart refers to as "other financing distortions"[Ref. 1,p.90]. This is done by adding the equity provided by preferred stockholders and minority investors to ***capital*** and by returning the income siphoned off by these sources of equity back into ***NOPAT*** [Ref. 1]. Mathematically the rate of return equation remains the same (see Equation 2 above), however, NOPAT and capital have more added to their equations:

$$\begin{aligned} \text{NOPAT} = {} & \text{Income available to common share holders} \\ & + \text{Preferred dividend} \\ & + \text{Minority interest provision} \\ & + \text{Interest expense after taxes} \end{aligned} \tag{5}$$

and

$$\begin{aligned} \text{Capital} = {} & \text{Common equity} \\ & + \text{Preferred stock} \\ & + \text{Minority interest} \\ & + \text{All debt} \end{aligned} \tag{6}$$

The third and final step in the Financing Perspective is to "eliminate accounting distortions"[Ref. 1] from the rate of return by adding equity equivalent reserves to ***capital*** and the change (from period based accounting) in the reserves to ***NOPAT***. [Ref. 1] Mathematically the changes look like this:

$$\begin{aligned} \text{NOPAT} = {} & \text{Income available to common share holders} \\ & + \text{Increase in equity equivalents} \\ & + \text{Preferred dividend} \\ & + \text{Minority interest} \\ & + \text{Interest expense after tax} \end{aligned} \tag{7}$$

and

$$\begin{aligned} \text{Capital} = {} & \text{Equity equivalents} \\ & + \text{Common equity} \\ & + \text{Preferred stock} \\ & + \text{Minority interest} \\ & + \text{All debt} \end{aligned} \tag{8}$$

Stewart [Ref. 1,pp.91&112] defines equity equivalents as items like deferred income tax reserve, the

LIFO inventory valuation reserve, the cumulative amortization of goodwill, unrecorded goodwill, a capitalization of R&D and other market-building outlays, (Net) capitalized intangibles, full-cost reserve, bad debt reserve, inventory obsolescence reserve, warranty reserve, deferred income reserve, cumulative unusual write-offs (less gains) after taxes.[Ref. 1]

b. The Operating Perspective

To obtain an equivalent to the deleveraged rate of return from the Operating Perspective start with sales as the major source of cash (where in the Financing Perspective common share holders were the major source of cash) in the calculation of ***NOPAT*** , then subtract recurring (operating) expenses and taxes. To arrive at a figure for ***capital*** simply add net working capital to net fixed assets. Where net working capital is current assets less non-interest-bearing current liabilities (accounts payable, accrued expenses, etc.) and fixed assets consist on net property, plant and equipment, goodwill, and other long-term capital necessary in the operation of the business.[Ref. 1] Mathematically, the rate of return equation from an Operating Perspective looks no different than before:

$$r = \frac{\text{NOPAT}}{\text{capital}} \tag{2}$$

However, NOPAT and Capital are calculated quite differently. NOPAT and capital defined mathematically, for this particular step, are as follows:

$$\begin{aligned} \text{NOPAT} = \quad & \text{Sales} \\ & - \text{Operating expenses} \\ & - \text{Taxes} \end{aligned} \tag{9}$$

and

$$\begin{aligned} \text{Capital} = \quad & \text{Net working capital} \\ & + \text{Net fixed assets} \end{aligned} \tag{10}$$

2. The Cost of Capital Calculation

Looking back at the EVA™ equation, EVA™ = (r - c*) x Capital [Equation 1][Ref. 1], the next variable we must tackle is ***c****, the cost of capital. Once again, Stewart [Ref. 1,pp. 280-285] computes it two different ways: 1) from a Financing Perspective, and 2) from an Operating Perspective. Both perspectives are best illustrated by example.

Suppose we have a hypothetical company, I'll call it BAILEYCORP (has a nice ring to it). BAILEYCORP has 500 shares of common stock outstanding. Its investor's required rate of return for the risk in the business (regardless of how the business is financed) is 10%. BAILEYCORP can borrow capital at 6%. The corporate tax rate for our hypothetical company is 40%. The management of BAILEYCORP has decided that it will have a Debt to Equity ratio of 1 to 1 (i.e. a capital structure of 50% debt and 50% equity). Using this information, let's compute BAILEYCORP's cost of capital, both with the Financing Approach and the Operational Approach.

a. The Financing Approach

In order to compute the cost of capital using the Financing Approach, we must first calculate the after-tax cost of both debt and equity. The after-tax cost of debt uses the following equation:

$$\textbf{After-tax cost of Debt} = (1 - t)b \qquad (11)$$

Where **t** is the corporate tax rate, and **b** is the interest rate charged to borrow capital. For BAILEYCORP the computation looks like this:

After-tax cost of Debt = (1 - t)b
After-tax cost of Debt = (1 - 40%)6%
After-tax cost of Debt = 3.6%

The after-tax cost of equity requires two computations, one to determine the Financial Risk Premium (FRP) and another to add FRP and required investor return to arrive at the after-tax cost of equity. Stewart [Ref. 1, p. 274] defines Financial Risk Premium as the compensation to "investors for suffering the additional variability over the business cycle in bottom-line earnings and hence in stock price." The equation to determine FRP is as follows:

$$\mathbf{FRP = (1 - t)(c - b)(Debt/Equity)} \qquad (12)$$

Where **t** is the corporate tax rate, **c** is the required return for the risk in the business (regardless of how the business is financed), and **b** is the interest rate charged to borrow capital. For BAILEYCORP the numbers fall out like this:

$$FRP = (1 - t)(c - b)(Debt/Equity)$$
$$FRP = (1 - 40\%)(10\% - 6\%)(1/1)$$
$$FRP = 2.4\%$$

The final step in the after-tax cost of equity is the addition of FRP and the investor's required base rate of return, this is done with the following equation:

$$\mathbf{y = c + FRP} \qquad (13)$$

Where **y** is the after-tax cost of equity, **c** is the investor's required base rate of return, and **FRP** is the Financial Risk Premium. BAILEYCORP's after-tax cost of equity calculation looks like this:

$$y = c + FRP$$
$$y = 10\% + 2.4\%$$
$$y = 12.4\%$$

Using a table to compute the weighted average cost of capital, BAILEYCORP's weighted average cost of capital is:

	(1) *After-Tax Cost*	(2) *Weight*	(3)=(1)x(2) *Weighted Cost*
Debt	3.6%	50%	1.80%
Equity	12.4%	50%	6.20%
c*			8.00%

(14)

b. The Operating Approach

The Operating Approach is exceedingly simple in comparison to the algebra exercise that the Financial Approach utilizes. There is but one relatively simple formula, as shown below:

$$c^* = c[1-t(D/TC)] \quad (15)$$

Where **c*** is the cost of capital, **c** is the required return for the risk in the business (regardless of how the business is financed), **t** represents the tax rate, **D** is the debt of the company, and **TC** is the total capital invested in the company.[Ref. 1] Using the Operating Approach BAILEYCORP's cost of capital stacks up as follows:

$$c^* = c[1-t(D/TC)]$$
$$c^* = 10\%[1-40\%(50\%)]$$
$$c^* = 8\%$$

3. Defining Capital

Recalling the EVA™ equation, **EVA™ = (r - c*) x Capital** [Equation 1][Ref. 1], the last variable requiring some explanation is **Capital**. Capital in the EVA™ equation refers to the economic book value of the capital committed to the business. Stewart[Ref. 1, p.91] defines economic book value as equity equivalents plus standard accounting book value. Equity equivalents and the make up of capital were described

in some detail in the rate of return section and nothing further would be gained by reviewing them at this point.

4. Summary

EVA™ is the residual income left over from operating profits after the cost of capital has been earned.[Ref. 1] Residual income as a financial management measurement tool is not a new or unique concept. However, the specific methods used by Stern Stewart & Company to arrive at rates of return and capital employed do appear to be unique. In the next chapter the methodology to test and determine if the information conveyed by the EVA™ measure is indeed unique will be laid out. The chapter that follows (Chapter IV) will contain the actual tests and analysis. Prior to getting into the methodology and analysis, however, a review of the literature about EVA™ is in order.

E. LITERATURE REVIEW

1. EVA™ as an Internal Performance Measure

The majority, if not nearly all, of the prior research and literature in the area of EVA™ deals with EVA™ as an internal performance measurement tool. As mentioned in chapter I, this thesis attempts to analyze the value of EVA™ as an information source to those external to the firm (in particular DOD and DON).

Prior to 1990 the EVA™ term did not exist. It was in 1990 that Bennett Stewart published his book ***The Quest for Value*** [Ref. 1] and in early 1991 that Stern Stewart & Company's Sarah Smith published ***The Best and Worst Performers in Corporate America*** [Ref. 3] in Corporate Finance magazine, both of which introduced the term of EVA™. To say that the EVA™ concept did not exist prior to the publications mentioned above is somewhat misleading. Obviously the basis and framework for EVA™ had been in the formulating stages for a long time prior to 1990 and related concepts such as residual

income and free cash flow existed.

Professor Michael Jensen (Harvard Business School) has examined the EVA™ concept (or its early predecessors) in his studies of corporate takeovers: ***THE MARKET FOR CORPORATE CONTROL The Scientific Evidence*** (Journal of Economic Finance 1983)[Ref. 4], ***Takeovers: folklore and science*** (Harvard Business Review 1984)[Ref. 5], ***The Takeover Controversy: Analysis and Evidence*** (Midland Corporate Finance Journal 1986, revised 1988)[Ref. 6], ***Eclipse of the Public Corporation*** (Harvard Business Review 1989)[Ref. 7], and ***Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers*** (American Economic Review 1986, revised 1991)[Ref. 8]. Most recently Professor Jensen referred to the EVA™ concept in an article concerning internal control systems, ***The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems*** (Journal of Finance 1993)[Ref. 9]. However, it is not until his most recent article [Ref. 9, p.32] that EVA™ is mentioned by name and then only as an internal control measure for R&D and capital expenditures.

Brian McWilliams, in an article for Enterprise magazine in April of 1993 titled ***CREATING VALUE*** [Ref. 10] and Stephen F. O'Byrne, in an article for Directorship magazine in September of 1994 titled ***EVA™, Management Compensation, and Shareholder Return*** [Ref. 11] discussed EVA™. However, Both McWilliams and O'Byrne treated EVA™ as a "management philosophy" and examined only its applications to internal controls such as executive compensation and capital budgeting.

An article written by Daniel J. McConville for Industry Week magazine in April of 1984 ***ALL ABOUT EVA*** [Ref. 12] hinted at EVA™ as an external information source, calling it a "yardstick" to "determine whether or not a company should be in business at all." The McConville article went on to say that "Stock prices seem to move in tandem with EVA calculations." However, the vast majority of the article

deals with EVA™ as a "management philosophy" and its basic internal financial control functions of capital budgeting and executive compensation. Mr. McConville's article appears to be based solely on interviews and contains no empirical data or reference to any type of study.[Ref. 12]

A September 1993 article in FORTUNE magazine, ***THE REAL KEY TO CREATING WEALTH*** [Ref. 13], by Shawn Tully touts EVA™ as "today's hottest financial idea and getting hotter." Mr. Tully asserts that businesses that use "the precepts of EVA ... have hugely increased the value of their companies." He makes this conclusion based on stock appreciation rates over a 10 year period for selected companies that adopted the EVA™ concept (six companies were listed by name, there was no other information on the sample size) and interviews with CEO's and CFO's whose companies have adopted EVA™.[Ref. 13]

Laura Walbert followed up the Tully article [Ref. 13] for FORTUNE magazine in December of 1993 with ***AMERICA'S BEST WEALTH CREATORS*** [Ref. 14]. The Walbert article concentrates on MVA™ and only discusses EVA™ as it is related to MVA™. The data and information listed in the article was all provided by Stern Stewart & Company. Ms. Walbert appears to have taken all of the Stern Stewart data at face value and apparently did not perform any independent calculations or comparisons.

In two yet to be published articles, ***EVA™: FACT AND FANTASY*** for the JOURNAL OF APPLIED CORPORATE FINANCE [Ref. 15] and ***REFORM YOUR GOVERNANCE FROM WITHIN*** for Directors & Boards [Ref. 16], G. Bennett Stewart III, himself, discusses EVA™. The articles are simply updated and very condensed versions of the key points found in his book ***The Quest for Value*** [Ref. 1]. The data, information, and studies used in the articles are the same as those found in the book. The updates consist, for the most part, of new anecdotes and analogies that back up his previous work.

2. EVA™ As An External Performance Measure

Perhaps the most significant examination of EVA™, for the purposes of this study, was done by Patrick T. Finegan (a partner at Stern Stewart & Company) in ***MAXIMIZING SHAREHOLDER VALUE AT THE PRIVATE COMPANY*** for the JOURNAL OF APPLIED CORPORATE FINANCE in the summer issue of 1991 [Ref. 17]. The title may, at first, seem incongruent with the subject of this study, as this study is examining the information value of EVA™ to those external to the business entity and in a private company there are few, if any (creditors perhaps?), interested outside parties. What the article deals with is maximizing the value of a private company just prior to taking it public. When a company goes public there are many people external to the firm that are very interested in the company's value. Mr. Finegan used plots (EVA versus MVA and Change in EVA versus Change in MVA) and regression (MVA versus EVA, Return on Capital, Return on Equity, Growth in Cash Flow, Bond Rating Score, Growth in Sales, Growth in Dividends, Growth in Assets, Growth in Capital, and Growth in Earnings Per Share). Mr. Finegan describes the methodology as follows:

> ...The survey also recasts traditional accounting statements into economically meaningful cash-based measures like EVA, enabling us to test how well markets measure performance.
>
> To filter out company-specific noise, Stern Stewart grouped 900 industrial companies into clusters of 25 arranged in order of MVA. We then plotted the MVA of these clusters against the average EVA of each grouping ...The consistency of relationship was startling. The same strong correlation was apparent when we analyzed *changes*[italics theirs] in MVA in relation to changes in EVA...For any diversified portfolio, EVA turned out to be an extremely powerful indicator of MVA, or the portfolio's premium or discount to economic book value.

> I recently extended the analysis to other measures. Returning to the sample of 900 industrials, I focused on the middle 450, where the MVAs were tightly clustered, and compared the explanatory power of EVA to more conventional performance measures like earnings per share, growth in capital, the return on capital, and even growth in cash flow...EVA outperformed the return on capital, return on equity, growth in cash flow, growth in dividends, and growth in assets - and exhibited *six times*[italics theirs] the explanatory power of earnings-per-share growth in determining MVA. I then repeated the analysis on changes in MVA and found EVA again the winner...[Ref. 18]

Based on his studies Mr. Finegan declared, "The single best periodic measure of performance is EVA"[Ref. 18]. He further elaborated:

> ...That markets conform to the EVA model of firm valuation is borne out by cross-sectional research of stock price performance over the last decade. Stern Stewart & Co. recently completed its second annual survey of America's top-performing companies ranked by total market value created or destroyed, net of capital retained or invested(Market Value Added, or "MVA"). Unlike conventional, size-based surveys MVA controls for both growth and profitability, providing a better glimpse of who has, and has not, created value for their shareholders...Whether they acknowledge it or not - and indeed they may not even be conscious that their methods collectively promote this result - sophisticated price-setting investors credit companies with the level and growth in EVA, and only coincidentally with the growth in EPS.... [Ref. 18]

As just discussed, Mr. Finegan concludes that EVA™ is the "single best periodic measure of performance." However, I believe that additional research will be necessary to determine if that conclusion is valid. A related question, on the other hand, is whether performance needs to be measured by a <u>single</u> measure. One issue addressed in this thesis is the

hypothesis that EVA™ can be surrogated by (a combination of) existing accounting measures. The next chapter outlines the methodology directed toward that and other thesis questions.

III. METHODOLOGY

A. INTRODUCTION

The research presented in this thesis is almost entirely empirical. The Economic Value Added (EVA™) measurement is analyzed to determine if the financial components, ratios, and assumptions that are used to construct EVA™ make it unique from commonly used accounting measures and ratios.

To determine if EVA™ is unique, both EVA™ and standard accounting measures from a sample of defense contractors are compared statistically. This process involves three steps. The first step is identifying an appropriate sample of firms and collecting financial and EVA™ data for the firms covering a specific period of time. The second step is selecting specific financial ratios to be included in the analysis. The third step is designing specific statistical tests of association between EVA™ and the selected financial ratios which would provide findings relevant to the thesis' research questions. Each of these steps is discussed in this chapter.

B. SAMPLE AND DATA

1. Selection of Sample Firms

The contractors analyzed were chosen utilizing the following criteria. First, the sample was limited to U.S. based companies and contractors only. Many large DON and DOD contractors are foreign owned and foreign based companies. Most foreign companies do not have the same financial reporting requirements as U.S. companies, making it difficult to obtain, analyze, and compare their financial statements with their U.S. counterparts; therefore, they were eliminated from the sample. Second, only contractors that do a large amount of business with DON/DOD were considered. The contractors were determined to be large contractors based on dollar size of contracts, number of contracts awarded, and

percentage of the DON/DOD procurement budget for Fiscal Year 1986. Fifty large contractors were identified by name in a graduate thesis, *Financial Ratio Patterns in the United States Defense Industry*, by CAPT G. Gursoy, TURKISH ARMY [Ref. 18]. The sections of Gursoy's methodology that are relevant to sample and data selection are included as Appendix A. Third, the number of contractors was further narrowed by finding the overlap between Gursoy's list [Ref. 18] and the Stern Stewart *Performance 1000* database, the source for the EVA™ data. There were 45 companies that met these criteria, they are listed on the following page.

List of DOD/DON Contractors included in study:

1. Allied-Signal, Inc.
2. A.T.& T.
3. Black & Decker Corp.
4. The Boeing Co.
5. Chrysler Corp.
6. The Coastal Corp.
7. Computer Science Corp.
8. CSX Corp.
9. E - Systems, Inc.
10. E.G.& G., Inc.
11. Eaton Corp.
12. Eastman Kodak
13. FMC Corp.
14. Ford Motor Co.
15. GTE Corp.
16. Gencorp Inc.
17. General Dynamics Corp.
18. General Electric Co.
19. General Motors Corp.
20. Grumman Corp.
21. Harris Corp.
22. Harsco Corp.
23. Hercules Inc.
24. Hewlett-Packard Co.
25. Honeywell, Inc.
26. IBM Corp.
27. ITT Corp.
28. Johnson Controls Inc.
29. Lockheed Corp.
30. Loral Corp.
31. Martin Marietta Corp.
32. McDonnell Douglas Corp.
33. Morrison Knudsen Corp.
34. Motorola, Inc.
35. Northrop Corp.
36. Olin Corp.
37. Raytheon Co.
38. Rockwell International
39. TRW Inc.
40. Teledyne, Inc.
41. Texas Instruments Inc.
42. Trinity Industries, Inc.
43. United Technologies Corp.
44. Unisys Corp.
45. Westinghouse Electric Corp.

2. Data and Time Period Studied

The ten year time period between 1983 and 1992 was chosen because it provided the most advantageous combination of both timeliness (recent enough to be useful) and comprehensiveness (long enough to include periods of both economic growth and contraction). Both EVA™ and traditional accounting data was collected for the sample firms covering the 10 year period. The EVA™ data was obtained from Stern Stewart Management Services, in the form of *The Stern Stewart PERFORMANCE 1000 The Definitive Guide to MVA and EVA™* (Stern Stewart Management Services, 1993)[Ref. 21]. The accounting data was obtained from the information gathered by CAPT G. Gursoy (TURKISH ARMY)for use in a graduate thesis, *Financial Ratio Patterns in the United States Defense Industry*, [Ref. 18]. The financial information of the defense firms in Gursoy's study were collected from company annual financial reports , company 10K reports filed with the Securities and Exchange Commission, or Moody's industrial manuals. Gursoy concluded that these three sources provided a sufficient amount of financial data for the study.

In Gursoy's study 30 specific financial information items were collected to calculate financial ratios. The financial information items were chosen by considering the ratios that would be calculated. These raw data items are listed on the following page.

RAW DATA LIST

Balance Sheet Items

1. Cash and marketable securities
2. Receivables
3. Inventory
4. Total current assets
5. Net plant, property, and equipment (fixed assets)
6. Total assets
7. Accounts payable and accrued expenses
8. Total current liabilities
9. Long term debt
10. Other long term liabilities
11. Total liabilities
12. Preferred stock
13. Retained earnings
14. Total stockholder's equity

Income Statement Items

15. Net sales
16. Cost of goods sold (COGS)
17. Total operating expenses
18. Net operating income
19. Interest expense
20. Income tax expense
21. "Total" income from continuing operations
22. Net Income
23. Earnings per share from continuing operations
24. Earnings per share from discontinuing operations

Cash Flow Statement

25. Cash flow from operations
26. Working capital from operations
27. Net capital expenditures
28. Depreciation, amortization, and depletion

Additional Data Items

29. Total revenue from government
30. Year

The financial information for each firms came from three primary sources:

- Balance sheet (statement of financial condition)
- The income statement (profit and loss statement)
- Cash flows statement (statement of changes in financial position)

C. MEASURES

There were two basic methods used to select the specific ratios to be included in the analysis, a "Comprehensive" method and the "Conceptual" method. The Comprehensive Method selects a wide set of ratios designed to comprehensively represent all possible accounting ratios. The comprehensive method assumes that ratios which might be relevant in explaining EVA™ cannot be identified in advance. Thus, a wide range of ratios should be included in the analysis and purely empirical techniques used to identify which specific ratios are most useful.

In contrast, the Conceptual Method assumes that a small set of ratios, likely to be most useful in explaining EVA™, can (and perhaps should) be identified in advance of testing. The empirical testing is then limited only to those ratios. This begs the question, what concepts might guide the selection of those ratios? Two conceptual approaches were used to facilitate ratio selection in this thesis. The first is the factor ratio classification approach, hereafter referred to as the factor approach, identified in Chen and Shimerda's, ***An Empirical Analysis of Useful Financial Ratios*** (Financial Management, Spring 1981)[Ref. 20], and ***THE STABILITY OF FINANCIAL PATTERNS IN INDUSTRIAL ORGANIZATIONS*** by Pinches, Mingo, and Caruthers (The Journal of Finance, May 1973)[Ref. 22]. These studies claim that there are seven

fundamental dimensions of financial condition reflected by existing and generally accepted financial ratios. The studies further claim that one specific ratio can be chosen to represent each dimension.

The second conceptual approach, referred to hereafter as the performance approach, rests on the concept that underlies EVA™. EVA™ is designed as a single summary measure of overall firm performance. Traditional accounting ratios which are typically seen as overall summary performance measures were selected to be compared to EVA™. Each of these approaches is more fully addressed in the Conceptual Method section.

Certain assumptions were necessary in computing the ratios given the limitations of the databases used in this study. The assumptions made in computing certain accounting formulas and ratios are included as Appendix B.

1. The Comprehensive Method

As stated previously, the Comprehensive Method selects ratios to represent all possible accounting ratios. Obviously, this could include an infinite number of ratios. Therefore, the ratios were limited to those currently in use by DOD contracting personnel. Those particular ratios are found in Appendix C of the ***Guide to Analysis of Financial Capabilities for Preaward and Postaward Reviews*** [Ref. 19]. This guide is used by the Defense Contract Management Command in the Contract Management Financial Services division. The guide contains 50 financial ratios, however the number of ratios used in the study was reduced to include only those whose components were in the databases provided by Gursoy [Ref. 18]. In the end, only 35 of the 50 ratios were used.

The 35 financial ratios chosen by the Comprehensive Method to be included in the analysis fall into five broad categories 1) Solvency Ratios, 2) Working Capital Ratios, 3) Leverage Ratios, 4) Coverage Ratios, and 5) Profitability Ratios. A complete list of the ratios selected for use in the

Comprehensive Method is contained on page 38. The ratios included in the analysis were as follows:

a. Solvency Ratios

- Absolute Liquidity Ratio

This ratio shows how much of a firm's current liabilities can be covered by its most liquid assets, cash and marketable securities.

$$\textbf{Absolute Liquidity Ratio} = \frac{\textbf{Cash + Marketable Securities}}{\textbf{Current Liabilities}} \quad (16)$$

- Acid Test Ratio

The Acid Test (also known as the Quick Ratio) Ratio is similar to the Absolute Liquidity Ratio, however the Acid Test Ratio additionally considers Net Accounts Receivable.

$$\textbf{Acid Test Ratio} = \frac{\textbf{Cash + Marketable Securities + Accounts Receivable (net)}}{\textbf{Current Liabilities}} \quad (17)$$

- Current Ratio

The Current Ratio, also called the working capital ratio, deals only with current assets and current liabilities. Current assets include: cash, marketable securities, accounts receivable, and inventory. Short term creditors prefer a high current ratio, however, too high of a current ratio may indicate inefficiency (too much capital tied up in nonproductive assets).

$$\textbf{Current Ratio} = \frac{\textbf{Current Assets}}{\textbf{Current Liabilities}} \quad (18)$$

- Accounts Payable to Sales Ratio

This ratio measures how a firm pays its creditors in relation to its sales volume. A low percentage is considered good.

$$\textbf{Accounts Payable to Sales Ratio} = \frac{\textbf{Accounts Payable}}{\textbf{Net Sales}} \quad (19)$$

- Assets to Sales Ratio

This ratio measures the percentage of investment in assets that is required to generate the current annual sales level. A high percentage is a possible indicator that a firm is not being aggressive enough in its marketing or it is not fully employing its assets. A low percentage may indicate that the firm is selling more than can safely be covered by its assets.

$$\textbf{Assets to Sales Ratio} = \frac{\textbf{Total Assets}}{\textbf{Net Sales}} \quad (20)$$

- Basic Defense Interval

This provides the period of time a firm can cover its cash expenses without additional financing should all revenues cease.

$$\textbf{Basic Defense Interval} = \frac{\textbf{365 (Cash + Receivables + Marketable Securities)}}{\textbf{Operating Expenses + Interest + Income Taxes}} \quad (21)$$

- Inventory Turnover Ratio

This ratio provides an indication of the liquidity of inventories. A low ratio is a possible indication that too much cash is tied up in inventories.

$$\textbf{Inventory Turnover Ratio} = \frac{\textbf{Cost of Goods Sold}}{\textbf{Average Inventory}} \qquad (22)$$

- Net Sales to Inventory Ratio

An annual increase in this ratio is often considered good, while a decline may indicate problems. A high ratio may indicate a loss of sales with customers buying somewhere else, or even a collection problem. A low ratio may indicate obsolete inventory, poor purchasing policies, or contingency stockpiling.

$$\textbf{Sales to Inventory Ratio} = \frac{\textbf{Net Sales}}{\textbf{Inventory}} \qquad (23)$$

b. Working Capital Ratios

- Cash available to Finance Operations Ratio

This ratio yields a rough indication of whether there is sufficient cash to finance current operations. It is similar to the basic defense ratio, except that depreciation is omitted from the denominator, as it is not a cash drain.

$$\textbf{Cash Available to Finance Operations Ratio} = \frac{\textbf{365 (Cash + Receivables + Marketable Securities)}}{\textbf{Operating Expenses - Depreciation + Interest + Income Taxes}} \qquad (24)$$

- Current Asset Turnover Ratio

This ratio is used to identify trends in the turnover and profitability of current assets.

$$\text{Current Asset Turnover Ratio} = \frac{\text{Cost of Goods Sold + Expenses + Interest + Taxes - Depreciation}}{\text{Average Current Assets}} \quad (25)$$

- Current Liabilities to Net Worth Ratio

This ratio provides a measure of the proportion of capital current creditors contribute to operations. It is also a measure of the amounts due to short term creditors as a percentage of the shareholders' investment. An increasing ratio indicates decreasing security for creditors.

$$\text{Current Liabilities to Net Worth Ratio} = \frac{\text{Current Liabilities}}{\text{Tangible Net Worth}} \quad (26)$$

- Current liabilities to Inventory Ratio

This ratio measures the extent to which a firm relies on sales to generate funds to pay current liabilities.

$$\text{Current Liabilities to Inventory Ratio} = \frac{\text{Current Liabilities}}{\text{Inventory}} \quad (27)$$

- Long Term Liabilities to Working Capital Ratio

Normally this ratio should not exceed 100%.

$$\text{Long Term Liabilities to Working Capital Ratio} = \frac{\text{Long Term Debt}}{\text{Net Working Capital}} \quad (28)$$

- Inventory to Net Working Capital Ratio

This ratio compares working capital to inventory value. Overstocking can lead to bankruptcy. Normally this ratio should not exceed 80%, however, it should always be compared to the industry average.

$$\text{Inventory to Net Working Capital} = \frac{\text{Inventory}}{\text{Net Working Capital}} \quad (29)$$

- Working Capital Turnover Ratio

This ratio indicates whether a firm is over invested in fixed, or slow, assets. It should always be compared to the industry average.

$$\text{Working Capital Turnover} = \frac{\text{Net Sales}}{\text{Net Working Capital}} \quad (30)$$

c. Leverage Ratios

- Debt and Preferred Ratio

This ratio measures the extent of financing contributed by creditors and preferred owners.

$$\text{Debt and Preferred Ratio} = \frac{\text{Long Term Debt + Preferred Funds}}{\text{Total Capital Employed}} \quad (31)$$

- Debt Ratio

This ratio measures the percentage of total funds supplied by creditors. Creditors normally prefer a lower ratio, but management may use leverage to produce a higher ratio.

$$\text{Debt Ratio} = \frac{\text{Current + Long Term Debt}}{\text{Total Assets}} \quad (32)$$

- Debt to Equity Ratio

This ratio provides the relative positions of creditors and owners.

$$\text{Debt to Equity Ratio} = \frac{\text{Long Term Debt + Preferred}}{\text{Common Stockholders' Equity}} \quad (33)$$

- Equity Ratio

This ratio shows the share of the firm's capital provided by equity holders.

$$\text{Equity Ratio} = \frac{\text{Common Shareholders' Equity}}{\text{Total Capital Employed}} \quad (34)$$

d. Coverage Ratios

- Cash Flow to Liabilities Ratio

This ratio is used to compare statements with a firm rather than industry, because of varying depreciation practices. Ideally , liquidity would increase as due dates for debt maturity approach.

$$\text{Cash Flow to Liabilities Ratio} = \frac{\text{Net Income + Depreciation}}{\text{Total Liabilities}} \quad (35)$$

- Current Assets to Total Liabilities Ratio

This ratio measures protection for both short and long term liabilities. A ratio in excess of 100% indicates that long term creditors may be paid out of working capital if the firm is liquidated.

$$\text{Current Assets to Total Liabilities Ratio} = \frac{\text{Current Assets}}{\text{Current + Long Term Debt}} \quad (36)$$

- Fixed Assets to Net Worth Ratio

Disproportionate investment in illiquid fixed assets decreases the amount of funds available for daily operations and can leave a firm vulnerable to unexpected hazards and adverse changes in the business climate.

$$\text{Fixed Assets to Net Worth Ratio} = \frac{\text{Fixed Assets (net) - Intangibles}}{\text{Tangible Net Worth}} \quad (37)$$

- Shareholders' Equity Ratio

A low ratio of equity to assets may precede difficulty in meeting interest charges and debt obligations.

$$\text{Equity Ratio} = \frac{\text{Shareholders' Equity}}{\text{Total Assets}} \quad (38)$$

- Tangible Net Worth to Total Debt Ratio

This ratio measures the proportion between the shareholders' capital and that contributed by creditors. It is the inverse of the debt ratio.

$$\text{Tangible Net Worth to Total Debt Ratio} = \frac{\text{Tangible Net Worth}}{\text{Total Debt}} \quad (39)$$

- Times Interest Earned Ratio

The margin between income and interest payments is considered a good indication of a firm's ability to meet interest payments.

$$\text{Times Interest Earned Ratio} = \frac{\text{Earnings Before Interest and Taxes}}{\text{Interest Expense}} \quad (40)$$

e. Profitability Ratios

- Capital Turnover Ratio

This ratio indicates whether investment is adequately proportionate to sales and whether a potential credit problem or management problem exists. A high ratio may indicate overtrading or undercapitalization, while a low ratio may indicate overcapitalization.

$$\textbf{Capital Turnover Ratio} = \frac{\textbf{Net Sales}}{\textbf{Tangible Net Worth}} \qquad (41)$$

- Gross Profit on Net Sales Ratio

This ratio provides the average mark up, or margin, on goods sold. It can help identify trends in a firm's credit policy, markups, purchasing, and general merchandising. It may vary widely among firms in the same industry, according to sales, location, size, and competition.

$$\textbf{Gross Margin Ratio} = \frac{\textbf{Gross Margin}}{\textbf{Net Sales}} \qquad (42)$$

- Management Rate of Return

This rate quantifies the efficient use of assets compared with a target rate of return.

$$\textbf{Rate of Return} = \frac{\textbf{Operating Income}}{\textbf{Fixed Assets + Net Working Capital}} \qquad (43)$$

- Net Operating Profit Ratio

When there are significant financial charges, this ratio is preferable to the return on assets ratio. Net profit to net worth is influenced by the method of financing.

$$\text{Net Operating Profit Ratio} = \frac{\text{Earnings Before Interest and Taxes}}{\text{Tangible Net Worth}} \quad (44)$$

- Net Profit to Tangible Net Worth Ratio

This ratio measures management's ability to realize an adequate return on the capital invested. It is often compared to and industry average.

$$\text{Net Profit Rate} = \frac{\text{Earnings After Taxes}}{\text{Tangible Net Worth}} \quad (45)$$

- Net Profit to Net Working Capital Ratio

Working capital provides the cushion to carry inventories and receivables and finance ordinary business operations.

$$\text{Net Profits to Net Working Capital} = \frac{\text{Earnings After Taxes}}{\text{Net Working Capital}} \quad (46)$$

- Operating Expenses Ratio

This ratio shows management's ability to adjust expense items to changing sales. Trend analysis identifies any problem category. The higher this ratio the more sales are being absorbed by expenses. In this equation total operating expenses include cost of goods sold, selling, administrative, and general expenses.

$$\text{Operating Expenses Ratio} = \frac{\text{Total Operating Expenses}}{\text{Net Sales}} \quad (47)$$

- Operating Ratio

This ratio measures the profitability of normal business operations. It is usually compared with industry averages.

$$\text{Operating Ratio} = \frac{\text{Operating Income}}{\text{Net Sales}} \tag{48}$$

- Rate of Return on Total Assets

This measures management's ability to earn a return on the firm's assets without regard to variations in the method of financing.

$$\text{Rate of Return on Total Assets} = \frac{\text{Earnings After Taxes + Interest Expense}}{\text{Average Total Assets during the Year}} \tag{49}$$

- Return on Sales

This rate is usually compared with the industry average. The higher the rate, the better the firm is able to survive a downturn. If the rate is low, a high turnover of inventory is required to obtain an adequate return of investment. This rate is normally fairly constant over time.

$$\text{Rate of Return on Sales} = \frac{\text{Earnings After Taxes}}{\text{Net Sales}} \tag{50}$$

Ratios Included in The Comprehensive Method (Full Set):

Solvency Ratios
1. Absolute Liquidity Ratio
2. Acid Test Ratio
3. Current Ratio
4. Accounts Payable to Sales Ratio
5. Assets to Sales Ratio
6. Basic Defense Interval
7. Inventory Turnover Ratio
8. Net Sales to Inventory Ratio

Working Capital Ratios
9. Cash Available to Finance Operations
10. Current Asset Turnover Ratio
11. Current Liabilities to Net Worth Ratio
12. Current Liabilities to Inventory Ratio
13. Long Term Liabilities to Working Capital Ratio
14. Inventory to Net Working Capital Ratio
15. Working Capital Turnover Ratio

Leverage Ratios
16. Debt and Preferred Ratio
17. Debt Ratio
18. Debt to Equity Ratio
19. Equity Ratio

Coverage Ratios
20. Cash Flow to Liabilities Ratio
21. Current Assets to Total Liabilities Ratio
22. Fixed Assets to Net Worth Ratio
23. Shareholders' Equity Ratio
24. Tangible Net Worth to Total Debt Ratio
25. Times Interest Earned Ratio

Profitability Ratios
26. Capital Turnover Ratio
27. Gross Profit on Net Sales Ratio
28. Management Rate of Return
29. Net Operating Profit Ratio
30. Net Profit to Tangible Net Worth
31. Net Profit to Net Working Capital
32. Operating Expenses Ratio
33. Operating Ratio
34. Rate of Return of Total Assets
35. Return on Sales

2. The Conceptual Method

As stated previously, the Conceptual Method involves two versions: 1) the factor approach and 2) the performance approach. What follows is a brief summary of the two different approaches.

a. The Factor Approach

Chen and Shimerda's study, ***An Empirical Analysis of Useful Financial Ratios*** (Financial Management, Spring 1981)[Ref. 20], hypothesized that many financial accounting ratios measure essentially the same thing. They started with a very large number of ratios and then empirically, using a technique called factor analysis, attempted to identify the basic fundamental dimensions of financial conditions which UNDERLIE all of the specific ratios. Their findings indicated that: 1) there are seven basic dimensions (or factors), and 2) individual ratios are correlated with these factors. What this implies is, that picking one ratio to represent each factor will yield a small set of ratios that still comprehensively reflects the dimensions of the financial conditions being studied.

Pinches, Mingo, and Caruthers' study, ***THE STABILITY OF FINANCIAL PATTERNS IN INDUSTRIAL ORGANIZATIONS*** (The Journal of Finance, May 1973)[Ref. 22], looked at the same seven factors and the ratios that represent them, however, they documented the ratios even further within the seven factors. They accomplished this by correlating each ratio to the financial condition it was designed to measure at for separate points in time (1951,1957,1963,1969).

The factor approach uses the findings of the two studies to select ratios to be used in this study. The first step was to eliminate all ratios that did not appear in both studies(References 20 and 22). The second step was to eliminate the ratios that required data that was not contained in the data base (Gursoy[Ref. 18]). The third step was to

select the ratio with the highest mean factor load (the sum of the four different factor loads for each of the years in the study divided by four) as identified in ***The Stability of Financial Patterns in Industrial Organizations*** [Ref. 22] from the ratios that remained. The ratios that were left are then the seven ratios that best reflect the seven dimensions of financial condition. Those ratios are as follows:

Factor 1 - Return on Investment Ratio

$$\text{Return on Investment} = \frac{\text{Net Income}}{\text{Net Worth}} \quad (51)$$

Factor 2 - Capital Turnover Ratio

$$\text{Capital Turnover} = \frac{\text{Sales}}{\text{Total Assets}} \quad (52)$$

Factor 3 - Financial Leverage Ratio

$$\text{Financial Leverage} = \frac{\text{Total Liabilities}}{\text{Total Assets}} \quad (53)$$

Factor 4 - Short-Term Liquidity Ratio

$$\text{Short-Term Liquidity} = \frac{\text{Current Assets}}{\text{Current Liabilities}} \quad (54)$$

Factor 5 - Cash Position Ratio

$$\text{Cash Position} = \frac{\text{Cash}}{\text{Total Assets}} \quad (55)$$

Factor 6 - Inventory Turnover Ratio

$$\text{Inventory Turnover} = \frac{\text{Inventory}}{\text{Sales}} \quad (56)$$

Factor 7 - Receivables Turnover Ratio

$$\text{Receivables Turnover} = \frac{\text{Quick Assets}}{\text{Sales}} \quad (57)$$

b. The Performance Approach

The second version of the Conceptual Method is the performance approach. EVA™ is a variation of residual income and residual income is essentially a summary performance measure. Therefore a direct comparison of EVA™ to some of the more common and widely used summary performance measures or ratios that can be calculated from traditional accounting data could prove to be valuable to this study. Five of the most widely used and generally accepted accounting measures of performance were identified. The performance measures chosen were: 1) Return on Total Assets (ROTA), 2) Return on Shareholders' Equity (ROE), 3) Operating Income Ratio, 4) Net Income Ratio, and 5) Return on Total Capital. Mathematically the measures are defined as follows:

- Return on Total Assets Ratio(ROTA)

$$\mathbf{ROTA = \frac{Net\ Income}{Total\ Assets}} \tag{58}$$

- Return on Shareholders' Equity Ratio(ROE)

$$\mathbf{ROE = \frac{Net\ Income}{Common\ Equity}} \tag{59}$$

- Operating Income Ratio

$$\mathbf{Operating\ Income\ Ratio = \frac{Operating\ Income}{Net\ Sales}} \tag{60}$$

- Net Income Ratio

$$\mathbf{Net\ Income\ Ratio = \frac{Net\ Income}{Net\ Sales}} \tag{61}$$

- Return on Total Capital Ratio(ROTC)

$$\mathbf{ROTC = \frac{Net\ Income}{Total\ Assets}} \tag{62}$$

D. TESTS OF ASSOCIATION

The previous section described what ratios and how they were selected to be included in the analysis. That selection process resulted in three sets of ratios:

- The Full Set

  A comprehensive set of 35 generally accepted accounting ratios. A complete list of the ratios in the Full Set is found on page 38.

- The Factor Set

  A set of seven ratios representing the basic dimensions of financial condition. A list of the seven ratios in the Factor Set is found on page 40.

- The Performance Set

  A set of five widely used and generally accepted accounting ratios used as summary performance measures. A list of the five ratios selected for the Performance Set is found on page 41.

This section describes what analysis, primarily tests of association between EVA™ and traditional financial ratios, were conducted.

Broadly, three different tests of association were utilized.

- Pairwise Correlation

  Pairwise correlation provides a direct measure of association between two variables.

- Multiple Regression

  Multiple regression provides evidence of the ability of multiple variables to jointly explain the dependent variable being studied.

- Stepwise Regression

Stepwise regression empirically selects, from a larger set, the smaller subset of variables which best explain the dependent variable being studied.

The three types of tests described above were conducted using the three different sets of ratios (Full, Factor, and Performance), as described in the following sections.

E. TESTS USED TO ANSWER THE RESEARCH QUESTIONS

1. The Primary Research Question

The purpose for doing tests of association, or any tests involving the research data, is to answer the research questions posed back in Chapter I. Those research questions are repeated here along with a description of the test used to provide findings relevant to the questions. The primary question was, "does the EVA™ measure provide information beyond what is currently available in traditional accounting measures?" The primary research question implies that traditional accounting ratios, from data taken a particular point in time should be able to explain EVA™ at the same particular point in time. Statistically this means that variance across firms in EVA™ can be explained by variance across firms in traditional accounting ratios. This relationship (or association) was tested using correlation, regression, and stepwise regression.

To test this relationship we first used the comprehensive method, correlating EVA™ with the Full Set of 35 different traditional financial accounting ratios, described previously in the Choice of Measures section. Simple regression, multiple regression, and stepwise regression were also used to compare EVA™ and the 35 traditional accounting ratios.

The next step in attempting to answer the primary research question narrowed the focus of the study to the

"Factor Approach", also identified in the Choice of Measures section. This approach uses seven basic financial functional groupings and then identifies financial accounting ratios that best represent the information within that group. Again, correlation and regression were used to compare the EVA™ measures with the seven representative ratios.

The final step taken in trying to answer the primary research question was the "Performance Approach", also described in the Choice of Measures section. In this approach five widely used and generally accepted summary performance measures were compared to the EVA™ measures, again using correlation and regression.

2. The First and Second Secondary Research Questions

The first question of the secondary research questions, "can EVA™ be surrogated by a simple combination of traditional accounting measures?", is very similar to the primary research question. It was tested with multiple regression and stepwise regression using the Comprehensive method, the Factor Approach, and The Performance Approach.

The second question of the secondary research questions, "is EVA™ statistically distinct from traditional accounting measures or does it show some degree of correlation to one or more of the traditional accounting measures?", is also very closely related to the primary research question. It was tested using correlation and regression, both multiple and stepwise, applied to all three of the different sets of ratios.

3. The Third and Fourth Secondary Research Questions

Lagged regression was used to shed light on secondary research questions three and four. Question three asked, "is past EVA™ an effective predictor of future EVA™" and question four asked, "given that a relationship does exist between EVA™ and some accounting ratios, how effective are those past accounting ratios at predicting future EVA™?"

4. The Fifth Secondary Research Question

The fifth, and final, secondary research question asked, "are there benefits to the U.S. Navy in using EVA™ ratings, in lieu of the traditional accounting measures now used, to evaluate potential contractors in Pre-Award Surveys?" This question was studied using all of the data and answers to the primary research question and all four of the previous secondary research questions. There is no one single definitive test that could answer this question. It is a subjective conclusion, supported by the data gathered in answering the previous questions.

The next chapter will contain the results of all the tests described in this section, as well as the descriptive statistics for the data involved. Following that will be the final chapter (Chapter V). Chapter V will contain conclusions and recommendations for further study in this area.

IV. ANALYSIS

The last chapter outlined the analysis, primarily tests of association, that were conducted in this study. This chapter will further elaborate on each test performed and discuss the results obtained from each of the tests. As stated in Chapter III, the purpose for performing these tests was to answer the research questions posed in the first chapter. Again, as in Chapter III, the research questions are repeated here with a description of the test and the relevant findings.

A. TESTS TO ANSWER THE PRIMARY RESEARCH QUESTION

The primary research question was, does the EVA™ measure provide information beyond what is currently available in traditional accounting measures? In attempting to answer the primary research question, the three methods described in the previous chapter were used. The Comprehensive Method was used first, then the Factor Approach (Conceptual Method), and then finally the Performance Approach (Conceptual Method). Within each method or approach, several different tests were actually run including pairwise correlation, regression (simple and multiple), and stepwise regression.

1. The Comprehensive Method

The first test performed was a pairwise correlation between the Full Set Ratios and EVA™ for the years 1983 through 1992. A complete list of the Full Set Ratios is found on page 38. In doing a correlation between the Full Set ratios and EVA™ it was expected that if EVA™ and one or more of the Full Set ratios were similar measures they would have a high correlation, and conversely, if EVA™ were unique none of the ratios would correlate to EVA™ to any significant degree. Table 1 lists the ratios and their correlation to EVA™. (Table 2 on pages 50 and 51 provides a key to the ratio

coefficient above 0.34. The highest correlations are for three profitability ratios (Net Operating Profit Ratio, Rate of Return on Total Assets, and Rate of Return on Sales), this is not surprising as EVA™ is itself a variation of a profitability measure. The only other ratio with a correlation of any significance was a cash flow ratio, the Cash Flow to Liabilities Ratio. This comes as something of a surprise because, as you may recall, EVA™ factors out the influence of leverage and the Cash Flow to Liabilities Ratio is heavily influenced by leverage (debt).

Table 1

EVA™/Full Set Correlation

RATIO	CORRELATION COEFFICIENT	RATIO	CORRELATION COEFFICIENT
ABSLIQ	0.06878	EQTRAT	-0.03444
ACIDT	0.20442	CFLIAB	0.32182
CURRAT	0.00309	CRATTL	0.08046
APSALE	-0.03335	FANW	-0.07240
ASSALE	-0.21993	SERAT	0.26379
BDI	0.03711	NWTD	0.14900
INTURN	0.02172	TINTER	0.16482
SALINV	0.01109	CAPTO	-0.00864
CASHOP	0.02507	GMRAT	-0.01269
CURATO	0.21188	MROR	-0.05293
CLNETW	-0.24067	OPPROF	0.33613
CLINV	-0.20534	NPROFR	0.29525
LTLWC	-0.01186	PRFNWC	-0.00309
INVWC	-0.01591	OPEXPR	-0.16756
WCTO	-0.01378	OPRAT	0.09911
DEBTPS	-0.14623	RORTA	0.32294
DETRAT	-0.12347	RORSAL	0.33781
DBEQTY	0.00455		

Table 2

Full Set Ratio Abbreviation Definitions

RATIO ABBREVIATION	FULL RATIO NAME
ABSLIQ	ABSOLUTE LIQUIDITY RATIO
ACIDT	ACID TEST RATIO
CURRAT	CURRENT RATIO
APSALE	ACCOUNTS PAYABLE TO SALES RATIO
ASSALE	ASSETS TO SALES RATIO
BDI	BASIC DEFENSE INTERVAL
INTURN	INVENTORY TURNOVER RATIO
SALINV	NET SALES TO INVENTORY RATIO
CASHOP	CASH AVAILABLE TO FINANCE OPERATIONS RATIO
CURATO	CURRENT ASSET TURNOVER RATIO
CLNETW	CURRENT LIABILITIES TO NET WORTH RATIO
CLINV	CURRENT LIABILITIES TO INVENTORY RATIO
LTLWC	LONG TERM LIABILITIES TO WORKING CAPITAL RATIO
INVWC	INVENTORY TO NET WORKING CAPITAL RATIO
WCTO	WORKING CAPITAL TURNOVER RATIO
DEBTPS	DEBT AND PREFERRED RATIO
DETRAT	DEBT RATIO
DBEQTY	DEBT TO EQUITY RATIO
EQTRAT	EQUITY RATIO

RATIO ABBREVIATION	FULL RATIO NAME
CFLIAB	CASH FLOW TO LIABILITIES RATIO
CRATTL	CURRENT ASSETS TO TOTAL LIABILITIES RATIO
FANW	FIXED ASSETS TO NET WORTH RATIO
SERAT	SHAREHOLDERS' EQUITY RATIO
NWTD	TANGIBLE NET WORTH TO TOTAL DEBT RATIO
TINTER	TIMES INTEREST EARNED RATIO
CAPTO	CAPITAL TURNOVER RATIO
GMRAT	GROSS PROFIT ON NET SALES RATIO
MROR	MANAGEMENT RATE OF RETURN
OPPROF	NET OPERATING PROFIT RATIO
NPROFR	NET PROFIT TO TANGIBLE NET WORTH RATIO
PRFNWC	NET PROFIT TO NET WORKING CAPITAL RATIO
OPEXPR	OPERATING EXPENSE RATIO
OPRAT	OPERATING RATIO
RORTA	RATE OF RETURN ON TOTAL ASSETS
RORSAL	RATE OF RETURN ON SALES

The next test utilized multiple regression setting EVA™ as the dependent variable to be explained by a combination of the Full Set ratios. The model had an adjusted R-squared of 0.4589 with a probability of error of 0.0001.

The last set of tests that were run, using the Full Set ratios in attempting to answer the primary research question, involved the use of stepwise regression. In this procedure the Statistical Analysis System (SAS) program was permitted to empirically add or remove ratios from the Full Set in order to most effectively explain the dependent variable EVA™. Statistically, the stepwise procedure continued to run as long as the additional variables were a significant addition to the model used to explain EVA™. (the cut off for significance was $p<=0.15$.). Table 3 on the following page summarizes the results of the stepwise regression procedure. The variable names are in abbreviated form; Table 2 on pages 50 and 51 provides the full names of the abbreviated ratios. The final model provided an R-squared of only 0.4836, using 12 of the 35 ratios. It is interesting to note that the ratios most highly correlated to EVA™ did not necessarily contribute significantly to the stepwise regression model. Specifically, the Net Operating Profit Ratio (corr. coeff. 0.33613) and the Cash Flow to Liabilities Ratio (corr. coeff. 0.332182) were not even included in the stepwise regression model.

In the next section the Conceptual Method will be evaluated, running the same tests again, this time using the Factor Set and the Performance Set ratios.

Table 3

Stepwise Regression: EVA™/Full Set Ratios

STEP	VARIABLE	PARTIAL R^2	MODEL R^2	PROBABILITY > F
1	RORSAL	0.1643	0.1643	0.0001
2	CURATO	0.0939	0.2581	0.0001
3	RORTA	0.0321	0.2902	0.0013
4	ASSALE	0.0506	0.3408	0.0001
5	BDI	0.0386	0.3794	0.0012
6	CURRAT	0.0182	0.3976	0.0085
7	CLINV	0.0195	0.4172	0.0057
8	ACIDT	0.0176	0.4347	0.0079
9	INTURN	0.0253	0.4600	0.0012
10	OPEXPR	0.0055	0.4655	0.1279
11	DEBTPS	0.0052	0.4707	0.1364
12	SERAT	0.0129	0.4836	0.0180

2. The Conceptual Method

a. The Factor Approach

Although the Factor Approach uses the same tests as the Comprehensive Method, the number of variables has been significantly reduced. The Factor Approach uses only seven ratios. A complete description of the Factor Approach is found on pages 39 and 40, and a list of the seven ratios can also be found on page 40.

The first test performed was a pairwise correlation between the Factor Set Ratios and EVA™ for the years 1983 through 1992. In doing a correlation between the Factor Set

ratios and EVA™, it was expected that if EVA™ and one or more of the Factor Set ratios were similar measures they would have a high correlation, and conversely, if EVA™ were unique, none of the ratios would correlate with EVA™ to any significant degree. Table 4, on the following page, lists the ratios and their correlation to the EVA™ variances. Table 5, also located on the following page, provides a key to the ratio abbreviations. None of the Factor Set ratios had a correlation coefficient above 0.33. It was not surprising to see that the only correlation of any significance was from the Return on Investment Factor (Return on Investment). The Return on Investment Ratio is, after all, a performance type measure. EVA™ is also a performance type measure.

Table 4

EVA™/Factor Set Correlation

RATIO	CORRELATION COEFFICIENT
ROI	0.32319
CPTURN	0.13996
FLEVER	-0.09689
CURRAT	0.00309
CSHPOS	0.08072
INVTRN	0.05600
RCVTRN	0.00023

Table 5

Factor Set Ratio Abbreviation Definitions

RATIO ABBREVIATION	RATIO FULL NAME
ROI	RETURN ON INVESTMENT RATIO
CPTURN	CAPITAL TURNOVER RATIO
FLEVER	FINANCIAL LEVERAGE RATIO
CURRAT	SHORT-TERM LIQUIDITY RATIO
CSHPOS	CASH POSITION RATIO
INVTRN	INVENTORY TURNOVER RATIO
RCVTRN	RECEIVABLES TURNOVER RATIO

The next test used multiple regression in trying to explain EVA™ with a combination of the Factor Set ratios. The model had an adjusted R-squared of 0.1762 with a probability of error of 0.0001. This was the expected result, as only one of the seven factors measures the same general area of financial performance, specifically, overall company financial performance.

The last set of tests that were run, using the Factor Set ratios in attempting to answer the primary research question, involved the use of stepwise regression. In this procedure the Statistical Analysis System (SAS) program was permitted to empirically add or remove ratios from the Full Set in order to most effectively explain the dependent variable EVA™. Statistically, the stepwise procedure continued to run as long as the additional variables were a significant addition to the model used to explain EVA™. (the cut off for significance was $p<=0.15$.). Table 6 on the following page summarizes the results of the stepwise regression procedure. The variable names are in abbreviated form, Table 5, on the previous page, provides the full names of the abbreviated ratios. Again, the results come as no surprise. The Return on Investment Ratio provided the most to the stepwise regression model, but not enough to bring the model R-squared any higher than 0.1881.

Table 6

Stepwise Regression: EVA™/Factor Set Ratios

STEP	VARIABLE	PARTIAL R^2	MODEL R^2	PROBABILITY > F
1	ROI	0.1057	0.1057	0.0001
2	CPTURN	0.0142	0.1198	0.0098
3	FLEVER	0.0471	0.1669	0.0001
4	INVTRN	0.0123	0.1793	0.0129
5	RCVTRN	0.0088	0.1881	0.0343

In the next section the other approach in the Conceptual Method will be evaluated, running the same tests again, this time using only the Performance Set ratios.

b. The Performance Approach

The Performance Approach uses the same tests as the Comprehensive Method and the Factor Approach, however, the number and choice of variables has been significantly modified. The Performance Approach uses five ratios. A complete description of the Performance Approach is found on page 41. A list of the five ratios is also located on page 41.

The first test performed was a pairwise correlation between the Performance Set Ratios and EVA™ for the years 1983 through 1992. In doing a correlation between the Performance Set Ratios and EVA™, it was expected that if EVA™ and one or more of the Performance Set Ratios were similar measures they would have a high correlation, and conversely, if EVA™ were unique none of the ratios would correlate with EVA™ to any significant degree. Table 7, on the following page, lists the ratios and their correlation to EVA™. Table 8, also on page 58, provides a key to the ratio abbreviations. None of the

Performance Set ratios had a correlation coefficient above 0.52. As expected, the Performance Set produced the highest correlations in the study. The Return on Total Capital Ratio produced the highest correlation coefficient in the study at 0.52195, the Net Income Ratio the second highest with 0.38687, and the Return on Total Assets Ratio the third highest at 0.35056. EVA™ is essentially a performance measurement, the fact that it correlates best with the Performance Set Ratios comes as no surprise.

Table 7

EVA™/Performance Set Correlation

RATIO	CORRELATION COEFFICIENT
ROTA	0.35056
ROE	0.01606
OPRAT	0.09911
NINCR	0.38687
ROTC	0.52195

Table 8

Performance Set Ratio Abbreviation Definitions

RATIO ABBREVIATION	RATIO FULL NAME
ROTA	RETURN ON TOTAL ASSETS RATIO
ROE	RETURN ON COMMON EQUITY RATIO
OPRAT	OPERATING INCOME RATIO
NINCR	NET INCOME RATIO
ROTC	RETURN ON TOTAL CAPITAL RATIO

The next test used multiple regression comparing EVA™ to a combination of the Performance Set ratio variances. The model had an adjusted R-squared of 0.1469 with a probability of error of 0.0001. This result was completely unexpected. With such high individual pairwise correlations and with the Performance Set Ratios being performance measures like EVA™, a much higher adjusted R-squared for the regression model was expected. This model had an adjusted R-squared lower than either of the previous two sets of ratios, a totally unanticipated outcome.

The last set of tests that were run, making use of the Performance Set Ratios in attempting to answer the primary research question, involved the use of stepwise regression. In this procedure the Statistical Analysis System (SAS) program was permitted to empirically add or remove ratios from the Full Set in order to most effectively explain the dependent variable EVA™. Statistically, the stepwise procedure continued to run as long as the additional variables were a significant addition to the model used to explain EVA™. (the cut off for significance was p<=0.15.). Table 9, below, summarizes the results of the stepwise regression procedure. The variable names are in abbreviated form, Table 8, on the previous page, provides the full names of the abbreviated ratios.

Table 9

Stepwise Regression: EVA™/Performance Set Ratios

STEP	VARIABLE	PARTIAL R^2	MODEL R^2	PROBABILITY OF ERROR
1	NINCR	0.1358	0.1358	0.0001
2	ROE	0.0161	0.1519	0.0067
3	ROTC	0.0053	0.1572	0.1167

This outcome came as something of a surprise, as well. The results from the multiple regression procedure indicated something like this may occur. However, the stepwise regression's model R-squared of only 0.1572 was even lower than the revised (and lowered) expectations.

The next section will examine the findings from the analysis of the secondary research questions.

B. TESTS TO ANSWER THE SECONDARY RESEARCH QUESTIONS

In this section the five secondary research questions will be re-examined along with the test results and tests that were conducted in attempting to answer them.

1. The First and Second Secondary Research Questions

The first of the secondary research questions, "can EVA™ be surrogated by a simple combination of traditional accounting measures?", is very similar to the primary research question. It was tested with multiple regression and stepwise regression using the Comprehensive method, the Factor Approach, and The Performance Approach. The results of these tests were described in the preceding sections concerning the primary research question.

It would be expected that if EVA™ could be surrogated by a simple combination of traditional accounting measures, then the multiple or stepwise regression would produce a model with a high (nearing 1.00) R-squared adjusted. Table 10, on the following page, summarizes the results. It is interesting to note that in both stepwise and multiple regression the Performance Set of ratios was least effective in explaining EVA™ and the Full Set, with its mixed bag of ratios, was best in explaining EVA™. Although no combination was particularly good in explaining EVA™, these results are opposite of what was expected at the outset of this study,but not totally surprising; the Full Set sample contains a larger number of ratios with which to explain EVA™.

Table 10

Multiple/Stepwise Regression Summary

	MULTIPLE REGRESSION	
VARIABLE SET	**ADJUSTED MODEL R^2**	**PROB. > F**
COMPREHENSIVE SET	0.4589	0.0001
FACTOR SET	0.1762	0.0001
PERFORMANCE SET	0.1469	0.0001
	STEPWISE REGRESSION	
VARIABLE SET	**MODEL R^2**	**PROB. > F**
COMPREHENSIVE SET	0.4836	0.0180
FACTOR SET	0.1881	0.0343
PERFORMANCE SET	0.1572	0.1167

The second question of the secondary research questions, "is EVA™ statistically distinct from traditional accounting measures or does it show some degree of correlation to one or more of the traditional accounting measures?", is also very closely related to the primary research question. It was examined using correlation and regression results from all three of the different approaches. As before, the results of these tests are described in the preceding sections concerning the primary research question.

If EVA™ were <u>not</u> unique nor statistically distinct from traditional accounting measures, then one or more of the accounting measures would correlate very highly (nearing 1.00) with EVA™. The highest correlation achieved among the Full

Set Ratios was 0.33781, the highest correlation found among the Factor Set Ratios was 0.32319, and the highest correlation achieved among the Performance Set Ratios was 0.52195. As stated before, these results were expected. It was further evidence of the power of EVA™ as a performance measurement tool. Additionally, if EVA™ were not unique nor statistically distinct from traditional accounting measures, then the multiple or stepwise regression would show a model with an R-squared near 1.00. The stepwise and multiple regression results are summarized on the previous page. The fact that none of the three sets of ratios in any combination provided much of an explanation of EVA™ was not a surprise. However, the superiority of the Full Set Ratios over the Performance Set Ratios was unexpected.

2. The Third and Fourth Secondary Research Questions

Question three asked, "is past EVA™ an effective predictor of future EVA™?" Question four asked, "given that a relationship does exist between EVA™ and some accounting ratios, how effective are those past accounting ratios at predicting future EVA™?" Lagged correlation and regression, both multiple and stepwise, were used to examine and evaluate secondary research question four.

The first step was to correlate current EVA™ measures with the previous years' EVA™ measures for question three and with the previous years' traditional accounting measures for question four. The latter was done for all three ratio sets (Full, Factor, and Performance). The results of those correlations are listed in Table 11. The abbreviations are essentially the same, except that "TM1" has replaced the last three letters to signify that the ratio is lagged one year. (The full ratio names for the Full Set Ratios can be found on pages 50 and 51. Full names for the Factor Set Ratio abbreviations are located on page 55. Page 58 contains the Performance Set Ratio abbreviation definitions.)

Table 11

Lagged Correlation: All Ratio Sets

RATIO	CORRELATION COEFFICIENT	RATIO	CORRELATION COEFFICIENT
APSTM1	0.07095	FANTM1	-0.05520
ACTM1	0.18972	SERTM1	0.24600
CURTM1	-0.04095	NWTM1	0.16617
APSTM1	-0.02090	TINTM1	0.15900
ASSATM1	-0.26069	CAPTM1	0.02570
BDITM1	0.01326	GMTM1	-0.05393
INTTM1	0.02474	MRORTM1	-0.13171
SALTM1	0.01254	OPPTM1	0.22228
CASTM1	0.00227	NPRTM1	0.19611
CURATM1	0.25388	PRFTM1	0.02220
CLNTM1	-0.25359	OPETM1	-0.06727
CLINTM1	-0.24735	OPRTM1	0.01600
LTLTM1	0.00626	RORATM1	0.24182
INVTM1	0.00761	RORSTM1	0.19593
WCTM1	0.00657	EQTTM1	-0.00273
DEBTM1	-0.11124	ROITM1	0.21073
DETRTM1	-0.12726	CPTTM1	0.15420
DBEQTM1	-0.03819	FLEVTM1	-0.08030
CFLTM1	0.27745	CSHTM1	0.10548
CRATM1	0.09985	INVTRTM1	0.06582

RATIO	CORRELATION COEFFICIENT	RATIO	CORRELATION COEFFICIENT
RCVTM1	-0.01088	ROTCTM1	0.27050
ROTATM1	0.25456	EVATM1	0.81782
ROETM1	0.00162		
NINCTM1	0.20896		

Of particular interest is the EVATM1 correlation, as this gets directly to secondary research question number three. "Is past EVA™ an effective predictor of future EVA™?" In order to answer yes to that question the EVA™/EVATM1 correlation should be high. The correlation between current EVA™ and the EVA™ lagged one year is 0.81782. This is by far the most statistically significant correlation in the study.

Simple regression revealed similar results. It yielded a model with an R-squared adjusted of 0.7513 and a probability of error of 0.0001. This is by far the highest and most significant R-squared adjusted in the study.

Referring to question four, "given that a relationship does exist between EVA™ and some accounting ratios, how effective are those past accounting ratios at predicting future EVA™?", all other lagged ratios had correlation coefficients of 0.27745 or less. Given the results from the previous research questions, showing little correlation between traditional accounting ratios and EVA™, it came as no surprise that there was little correlation between past traditional accounting ratios and current EVA™.

Multiple and stepwise regression rounded out the testing for question four. Using the Full Set Lagged Ratios, multiple regression yielded an R-squared adjusted of 0.5009 with a probability of error of 0.0001 and stepwise regression

provided a model with an R-squared of 0.5359 and a probability of error of 0.0951. Using the Factor Set Lagged Ratios, multiple regression yielded an R-squared adjusted of 0.1686 with a probability of error of 0.0001 and stepwise regression provided a model with an R-squared of 0.1975 and a probability of error of 0.1012. Using the Performance Set Lagged Ratios, multiple regression yielded an R-squared adjusted of 0.0708 with a probability of error of 0.0001 and stepwise regression yielded a model with an R-squared of 0.0795 and a probability of error of 0.0001. These results are consistent with the findings comparing the current ratio sets (Full, Factor, and Performance) with current EVA™.

3. The Fifth Secondary Research Question

The fifth, and final, secondary research question asked, "are there benefits to the U.S. Navy in using EVA™ ratings, in lieu of the traditional accounting measures now used, to evaluate potential contractors in Pre-Award Surveys?" This question was evaluated using all of the data and answers to the primary research question and all four of the previous secondary research questions. There is no one single definitive test that could answer this question. It is a subjective conclusion, and is supported by the data gathered in answering the previous questions.

C. SUMMARY

This entire chapter has in itself been a summary. Specifically, it has been a summary of findings. It has summarized the primary and secondary research questions, the tests that were conducted in attempting to answer them along with their corresponding test results.

The next, and final, chapter (Chapter V) will contain conclusions drawn from this research and recommendations for further study in this area.

V. CONCLUSIONS

In the previous chapters the Background of the EVA™ measure has been discussed and explained, the research questions that this study addresses have been posed, the methodology used to administer the tests that were run was carefully laid out, and in the last chapter (Chapter IV) the results of the testing were presented. In this chapter the research questions will be answered based on the findings presented in Chapter IV, recommendations for further study in this area will also be presented.

A. THE PRIMARY RESEARCH QUESTION

Is EVA™ unique? The primary research question asked, "does the EVA™ measure provide information beyond what is currently available in traditional accounting measures?" In attempting to answer this question, three approaches, the Comprehensive Method, the Factor Approach(Conceptual Method), and the Performance Approach(Conceptual Method), were used. All three approaches were described in the previous chapter.

The first test performed was a pairwise correlation between the Full Set Ratios and EVA™ for the years 1983 through 1992. It was expected that if EVA™ and one or more of the Full Set ratios were similar measures they would have a high (approaching 1.00) correlation, and conversely, if EVA™ were unique none of the ratios would correlate with EVA™ to any significant degree. None of the Full Set Ratios had a correlation coefficient above 0.34. Table 1, on page 49, lists the ratios and their correlation to EVA™.

The next test performed was a pairwise correlation between the Factor Set Ratios and EVA™ for the years 1983 through 1992. None of the Factor Set ratios had a correlation coefficient above 0.33. Table 4, page 55, lists the ratios and their correlation to EVA™.

The last correlation performed was a pairwise correlation between the Performance Set Ratios and EVA™ for the same years. None of the Performance Set ratios had a correlation coefficient above 0.52. Table 7, on page 58, lists the ratios and their correlation to EVA™.

Based on the pairwise correlation test results it is my preliminary conclusion that EVA™ is unique and does provide information beyond the accounting ratios to which it was compared. None of the ratios tested had a correlation coefficient higher than 0.52. This indicates that the best comparable ratio could explain only 27% of EVA™ (i.e. providing the same or similar information). Simply put, EVA™ supplies 73% different information than the best comparable traditional accounting ratio.

To test if some combination of the sample accounting ratios could collectively explain EVA™, a series of slightly more aggressive tests were run. Again, the same set of ratios were utilized and the tests conducted in the same order (Comprehensive, Factor, then Performance). The first test performed was multiple regression, attempting to explain EVA™ with a combination of the Full Set ratios. The model had an adjusted R-squared of 0.4589 with a probability of error of 0.0001. The next test used multiple regression attempting to explain EVA™ with a combination of the Factor Set ratios. The model had an adjusted R-squared of 0.1762 with a probability of error of 0.0001. The final test using multiple regression to explain EVA™ used a combination of the Performance Set ratios. The model had an adjusted R-squared of 0.1469 with a probability of error of 0.0001.

The last set of tests that were run attempting to answer the primary research question, involved the use of stepwise regression. In this procedure the regression program was permitted to empirically add or remove ratios from the Full Set in order to most effectively explain the dependent

variable EVA™. Statistically, the stepwise procedure continued to run as long as the additional variables were a significant addition to the model used to explain EVA™. (the cut off for significance was p<=0.15.). Table 3 on page 53 summarizes the results of the stepwise regression procedure for the Full Set Ratios. The model produced using stepwise regression and the Full Set Ratios had 12 variables, an R-squared of 0.4836 and a probability of error of 0.0180. The next tests that were run, used the Factor Set ratios and stepwise regression. Table 6 on page 57 summarizes the results of the stepwise regression procedure for the Factor Set. The model produced using stepwise regression and the Factor Set Ratios had 5 variables, an R-squared of 0.1881 and a probability of error of 0.0343. The last tests that were run, used the Performance Set ratios and stepwise regression. Table 9, page 59, summarizes the results of the procedure. The model produced using stepwise regression and the Performance Set Ratios had 3 variables, an R-squared of 0.1572 and a probability of error of 0.1167.

Given the low R-squared values and the increased probability of errors, it appears that no combination of traditional accounting ratios can adequately explain EVA™. This evidence, coupled with the correlation findings, leads to the conclusion that EVA™ is unique and does provide information that is different from what is currently available in traditional accounting measures.

B. SECONDARY RESEARCH QUESTIONS ONE AND TWO

The first question of the secondary research questions, "can EVA™ be surrogated by a simple combination of traditional accounting measures?", is very similar to the primary research question. It was tested with multiple regression and stepwise

regression using the Comprehensive method, the Factor Approach, and The Performance Approach. The results of these tests were described in the preceding sections concerning the primary research question.

It would be expected that if EVA™ could be surrogated by a simple combination of traditional accounting measures, then the multiple or stepwise regression would produce a model with a high (nearing 1.00) R-squared adjusted. Table 10, below, reproduced from Chapter IV summarizes the multiple and stepwise regression results for all three data sets.

Table 10
Multiple/Stepwise Regression Summary

	MULTIPLE REGRESSION	
VARIABLE SET	**ADJUSTED MODEL R^2**	**ERROR PROB.**
COMPREHENSIVE SET	0.4589	0.0001
FACTOR SET	0.1762	0.0001
PERFORMANCE SET	0.1469	0.0001
	STEPWISE REGRESSION	
VARIABLE SET	**MODEL R^2**	**ERROR PROB.**
COMPREHENSIVE SET	0.4836	0.0180
FACTOR SET	0.1881	0.0343
PERFORMANCE SET	0.1572	0.1167

Clearly, no combination of traditional accounting measures can explain the year to year EVA™ variances. The best Combination of Variables yields an R-squared of only 0.4836 and that model has a relatively high probability of error at 0.0180.

The second question of the secondary research questions, "is EVA™ statistically distinct from traditional accounting measures or does it show some degree of correlation to one or more of the traditional accounting measures?", is also very closely related to the primary research question. It was examined using correlation and regression results using all three of the ratio sets. As before, the results of these tests were described in the preceding sections concerning the primary research question.

If EVA™ were <u>not</u> unique nor statistically distinct from traditional accounting measures, then one or more of the accounting measures' variances would correlate very highly (nearing 1.00) with the variances of EVA™. They did not. The highest correlation achieved among the Full Set Ratios was 0.33781, the highest correlation found among the Factor Set Ratios was 0.32319, and the highest correlation achieved among the Performance Set Ratios (and not surprisingly the highest in the study - as EVA™ <u>is</u> a performance measure) was 0.52195. Furthermore, if EVA™ were not unique nor statistically distinct from traditional accounting measures, then the multiple or stepwise regression would show a model with an R-squared near 1.00. Again, they were not even close. The stepwise and multiple regression results were summarized on the previous page.

Given the evidence, it is my conclusion that EVA™ cannot be surrogated by a simple combination of traditional accounting measures. Additionally, I believe the evidence supports the conclusion that EVA™ is statistically distinct from traditional accounting measures.

C. SECONDARY RESEARCH QUESTIONS THREE AND FOUR

Secondary research question three asked, "is past EVA™ an effective predictor of future EVA™?" Question four asked, "given that a relationship does exist between EVA™ and some accounting ratios, how effective are those past accounting ratios at predicting future EVA™?" Lagged regression was used to answer question three and lagged correlation and regression, both multiple and stepwise, were used to examine and evaluate question four.

The first step was to correlate current EVA™ measures with the previous years' EVA™ measures for question three. Current EVA™ measures were also correlated with the previous years' traditional accounting measures for question four, for all three ratio sets (Full, Factor, and Performance). The results of that correlation are listed in Table 11, pages 63 and 64.

The most revealing statistic was the EVATM1 correlation, as this gets directly to the answer for secondary research question number three. "Is past EVA™ an effective predictor of future EVA™?" In order to answer yes to that question the EVA™/EVATM1 correlation should be high (near 1.00). The between current EVA™ and EVA™ lagged one year yielded a correlation coefficient of 0.81782. This was by far the highest and most statistically significant correlation in the study.

Simple regression revealed similar results. It yielded a model with an R-squared adjusted of 0.7513 and a probability of error of 0.0001. This was also the highest R-squared adjusted in the study. Given the high correlation combined with the regression procedure findings, my conclusion is that, yes, past EVA™ exhibits some value in predicting future EVA™.

Looking back, question four was, "given that a relationship does exist between EVA™ and some accounting

ratios, how effective are those past accounting ratios at predicting future EVA™?". The results of the pairwise correlation tests showed that all lagged ratios had correlation coefficients of 0.27745 or less. Multiple and stepwise regression were used to complete the testing for question four. Using the Full Set Lagged Ratios, multiple regression yielded an R-squared adjusted of 0.5009 with a probability of error of 0.0001 and stepwise regression provided a model with an R-squared of 0.5359 and a probability of error of 0.0951. Using the Factor Set Lagged Ratios, multiple regression provided an R-squared adjusted of 0.1686 with a probability of error of 0.0001 and stepwise regression provided a model with an R-squared of 0.1975 and a probability of error of 0.1012. Using the Performance Set Lagged Ratios, multiple regression yielded an R-squared adjusted of 0.0708 with a probability of error of 0.0001 and stepwise regression yielded a model with an R-squared of 0.0795 and a probability of error of 0.0001. The low correlation values in conjunction with the regression findings indicate that little relationship exists between past account ratios and EVA™. Therefore, it is my conclusion that past accounting ratios are ineffective in attempting to predict future EVA™.

D. SECONDARY RESEARCH QUESTION FIVE

The fifth, and final, secondary research question asked, "are there benefits to the U.S. Navy in using EVA™ ratings, in lieu of the traditional accounting measures now used, to evaluate potential contractors in Pre-Award Surveys?" This question was evaluated using all of the data and answers to the primary research question and all four of the previous secondary research questions. There is no one single definitive test that could answer this question. It is a subjective conclusion, and is supported by the data gathered

in answering the previous questions.

My conclusion is a qualified maybe. The research conducted in this study does not lend itself to a direct answer to this question. EVA™ appears to be a unique and statistically distinct measure. However, this study did not address how well EVA™ measures what it is intended to measure. Had traditional accounting ratios adequately explained EVA™, then it could be concluded that EVA™ has little added value. However, traditional accounting ratios did not adequately explain EVA™. Therefore it is safe to conclude that EVA™ may be of potential value to the Navy. The findings in this study were sufficient to establish that EVA™ is a unique and statistically distinct measure, but were not sufficient to conclude that EVA™ is valuable in any specific decision context.

E. RECOMMENDATION FOR FURTHER RESEARCH

This thesis broke the ground for Navy research in the area of EVA™. It was, however, not a comprehensive evaluation of EVA™. Areas in the EVA™ field that I feel would benefit from further research are as follows:

- An evaluation of EVA™ in predicting corporate performance, both as a predictor of success and of failure.

- A further comparison of EVA™ with a greater number of traditional accounting ratios (including Earnings Per Share).

- An evaluation of MVA™ in predicting corporate performance, both as a predictor of success and of failure.

F. SUMMARY

In this thesis one primary research question and five secondary research questions were posed and answered. In Chapter II an in depth background and thorough explanation of EVA™ was given. A review of the current literature about the EVA™ measure was presented. The methodology and tests of association designed to answer the six research questions were laid out in Chapter III. The tests were conducted and the results and analysis were presented in Chapter IV. This chapter (Chapter V) presented the conclusions drawn from this study. A summary of the research questions and conclusions follows:

- The primary research question. *Does the EVA™ measure provide information beyond what is currently available in traditional accounting measures?* **Answer:** Yes, EVA™ appears to provide information not found in traditional accounting ratios.

- The first secondary research question. *Can EVA™ be surrogated by a simple combination of traditional accounting measures.* **Answer:** No. EVA™ cannot be surrogated by a simple combination of traditional accounting measures.

- The second secondary research question. *Is EVA™ statistically distinct from traditional accounting measures or does it show some degree of correlation to one or more of the traditional accounting measures?* **Answer:** Yes. It is statistically distinct. No, it does not show a significant degree of correlation to any traditional accounting measures.

- The third secondary research question. *Assuming EVA™ does measure some ultimate success criterion, thus making it a plausible objective of any firm to maximize EVA™, are past EVA™ ratings an effective predictor of future performance/EVA™ ratings.* **Answer:** Yes. Past EVA™ ratings appear to be an effective predictor of future EVA™ ratings.

- The fourth secondary research question. *Assuming EVA™ does measure some ultimate success criterion, thus making it a plausible objective of any firm to maximize EVA™, do past accounting ratios/measures predict future EVA™ ratings.* **Answer:** No. There is very little correlation between <u>any</u> accounting measure, past or current, and EVA™.

- The fifth, and final, secondary research question. *Are there benefits to the U.S. Navy in using EVA™ ratings, in lieu of the traditional accounting measures now used, to evaluate potential contractors in Pre-Award Surveys?* **Answer:** Maybe. The research in this thesis did not address the effectiveness of the EVA™ measure directly. However, the finding that EVA™ contains information not found in traditional accounting ratios is a necessary condition for EVA™ to have potential value in DOD financial analysis applications.

APPENDIX A. GURSOY'S SAMPLE AND DATA METHODOLOGY

SAMPLE FIRMS This study focused on the years from 1983 to 1992. This time span was chosen to assess whether the financial characteristics of the defense industry ratios changed during a period when the environment of the industry clearly did change. Since the defense industry experienced both economic stress and defense budget reductions during that time span, it seemed reasonable to use financial data for that ten year time period.

Data for 50 defense related firms was collected in order to represent the overall industry. In order to identify members of the defense industry, DOD contractors were examined. Companies were selected from among the top 100 defense contractors to U.S. government listed in the "Top 100 Prime Defense Department Contractors for FY 1990." (Source: Directorate for Information Operations and Reports, Department of Defense, Released 1991) Two criteria were considered in choosing a representative sample: size and diversity. The largest DoD contractors were selected, as measured by total assets and net contract value. And firms were selected to represent diverse industry sectors (or subindustries) within the broad area of defense contracting.

APPENDIX B. ACCOUNTING FORMULAE AND RATIO ASSUMPTIONS

Certain assumptions were necessary in computing the ratios given the limitations of the databases used in this study. The assumptions made in computing certain accounting formulas and ratios are as follows:

1. Year end inventory was used for both inventory and average inventory.

2. Total capital was defined to equal the sum of long term debt and total shareholders' equity.

3. Total current debt was defined as total current liabilities less the sum of accounts payable and accrued expenses.

4. Common equity was defined to equal total shareholders' equity less the sum of retained earnings and preferred shares.

5. Tangible net worth was defined as the sum of total assets less total liabilities and retained earnings less preferred shares.

6. Gross margin was defined to be net sales less cost of goods sold.

7. Operating income was defined as gross margin less operating expenses.

8. Net working capital was defined as current assets less current liabilities.

9. Earnings before taxes (EBT) was assumed to be the same as earnings before interest and taxes (EBIT).

10. Year end total assets were used for both total assets and average total assets.

11. Quick assets was defined as the sum of cash, marketable securities, and receivables.

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